

I Claim:

1. A method for predicting the behavior of a technical system starting from prescribed system properties, boundary conditions, and/or starting from prescribed influences on the system, the method which comprises the following steps:

providing a computer system;

providing a system of equations describing the technical system, the equations having the form $f(t, \underline{x}(t), \dot{\underline{x}}(t), \dots, \underline{x}^{(k)}(t), \underline{p}) = 0$, and including:

$$f_1(t, \underline{x}(t), \dot{\underline{x}}(t), \dots, \underline{x}^{(k)}(t), \underline{p}) = 0,$$

$$f_2(t, \underline{x}(t), \dot{\underline{x}}(t), \dots, \underline{x}^{(k)}(t), \underline{p}) = 0,$$

⋮

$$f_n(t, \underline{x}(t), \dot{\underline{x}}(t), \dots, \underline{x}^{(k)}(t), \underline{p}) = 0,$$

wherein $\underline{x}(t)$ and derivatives $\dot{\underline{x}}(t), \dots, \underline{x}^{(k)}$ thereof in each case have m elements, and \underline{p} is a parameter vector that can occur in the system of equations; and

executing a test method for providing error information relating to inconsistencies in the system of equations on the computer system, the test method having the following steps 1 to 3:

step 1: setting up a dependence matrix \underline{A} with m columns and n rows, and setting an element \underline{A} to

$\underline{A}(i,j) \neq 0$ when an i^{th} row of \underline{f} defined with $\underline{f}_i(t, \underline{x}(t), \dot{\underline{x}}(t), \dots, \underline{x}^{(k)}(t),)$ is a function of

- a) a j^{th} element of \underline{x} expressed as $\underline{x}_j(t)$; or
- b) one of the derivatives of the j^{th} element of \underline{x} defined as $\underline{x}_j^{(s)}(t)$;

and otherwise setting the element $\underline{A}(i, j) = 0$;

step 2: determining a set of row ranks each having the numbers of those rows of the dependence matrix \underline{A} that are mutually dependent and determining a set of column ranks of the dependence matrix \underline{A} each having the numbers of those columns of the dependence matrix \underline{A} that are mutually dependent if such row ranks and/or column ranks are present; and

step 3: outputting error information containing the numbers contained in each row rank determined in step 2 and in each column rank determined in step 2.

2. The method according to claim 1, which further comprises:

prior to executing step 1:

applying an equation significance list of length n in which each equation of the system of equations is assigned at least one of an equation number and an item of equation text information; and

applying a component significance list of length m in which each component of a solution vector \underline{x} is assigned at least one of a component number and an item of component text information;

in step 3, outputting at least one of the equation number and the item of equation text information in accordance with the equation significance list instead of outputting the numbers contained in each row rank; and

in step 3, outputting at least one of the component number and the item of component text information in accordance with the component significance list instead of outputting the numbers contained in each column rank.

3. A computer program with computer-executable instructions for executing a method for numerical simulation of a technical system according to claim 1.

4. A computer program with computer-executable instructions for executing a method for numerical simulation of a technical system according to claim 2.

5. A computer system programmed to execute a method for numerical simulation of a technical system according to claim 1.

6. A computer system programmed to execute a method for numerical simulation of a technical system according to claim 2.

7. A computer-readable medium having computer-executable instructions for performing the method according to claim 1.

8. A computer-related method, comprising: downloading a computer program product or a computer program with computer-executable instructions for executing a method for numerical simulation of a technical system according to claim 1 from an electronic data network onto a computer connected to the data network.

9. The method according to claim 8, wherein the electronic data network is the Internet.

10. A computer program product and computer program for providing error information relating to inconsistencies in a system of equations to be solved with the aid of a computer program running on a computer or with the aid of an analog

computer, which product is designed in such a way that it is possible to execute a method for providing error information relating to inconsistencies in a system of equations to be solved with the aid of a computer program running on a computer or with the aid of an analog computer and is of the form $\underline{f}(t, \underline{x}(t), \dot{\underline{x}}(t), \dots, \underline{x}^{(k)}(t), \underline{p}) = \underline{0}$, that is to say

$$\underline{f}_1(t, \underline{x}(t), \dot{\underline{x}}(t), \dots, \underline{x}^{(k)}(t), \underline{p}) = \underline{0},$$

$$\underline{f}_2(t, \underline{x}(t), \dot{\underline{x}}(t), \dots, \underline{x}^{(k)}(t), \underline{p}) = \underline{0},$$

⋮

$$\underline{f}_n(t, \underline{x}(t), \dot{\underline{x}}(t), \dots, \underline{x}^{(k)}(t), \underline{p}) = \underline{0},$$

where $\underline{x}(t)$ and derivatives $\dot{\underline{x}}(t), \dots, \underline{x}^{(k)}(t)$ thereof respectively have m elements, and \underline{p} is a parameter vector that can occur in the system of equations; and

the method comprising the following steps:

step 1: setting up a dependence matrix \underline{A} with m columns and n rows, and setting an element \underline{A}_{ij} to

$\underline{A}_{ij} \neq 0$ when an i^{th} row of \underline{f} defined with $\underline{f}_i(t, \underline{x}(t), \dot{\underline{x}}(t), \dots, \underline{x}^{(k)}(t))$ is a function of

a) a j^{th} element of \underline{x} expressed as $\underline{x}_j(t)$; or

b) one of the derivatives of the j^{th} element of \underline{x} defined as $\underline{x}_j^{(s)}(t)$;

and otherwise setting the element $\underline{A}(i,j)=0$;

step 2: determining a set of row ranks each having the numbers of those rows of the dependence matrix \underline{A} that are mutually dependent and determining a set of column ranks of the dependence matrix \underline{A} each having the numbers of those columns of the dependence matrix \underline{A} that are mutually dependent if such row ranks and/or column ranks are present; and

step 3: outputting error information containing the numbers contained in each row rank determined in step 2 and in each column rank determined in step 2.

11. The computer program product and computer program according to claim 10, wherein the method for providing error information relating to inconsistencies further comprises:

prior to executing step 1:

applying an equation significance list of length n in which each equation of the system of equations is assigned at least one of an equation number and an item of equation text information; and

applying a component significance list of length m in which each component of a solution vector \underline{x} is assigned at least one of a component number and an item of component text information;

in step 3, outputting at least one of the equation number and the item of equation text information in accordance with the equation significance list instead of outputting the numbers contained in each row rank; and

in step 3, outputting at least one of the component number and the item of component text information in accordance with the component significance list instead of outputting the numbers contained in each column rank.

12. A data carrier with a computer program product or computer program according to claim 10.

13. A data carrier with a computer program product or computer program according to claim 11.

14. The computer program product or computer program according to claim 10 carried in a computer-readable medium.

15. The computer program product or computer program according to claim 11 carried in a computer-readable medium.

16. A computer system programmed to execute the instructions contained in the computer program product or computer program according to claim 10.
17. A computer system programmed to execute the instructions contained in the computer program product or computer program according to claim 11.
18. A method for predicting a behavior of a system, which comprises programming the computer system according to claim 16 with at least one of prescribed system properties, boundary conditions, and starting from prescribed influences on the system, and predicting the behavior of the system by executing the computer program.
19. A computer-related method, comprising: downloading a computer program product or a computer program according to claim 10 from an electronic data network onto a computer connected to the data network.
20. The method according to claim 19, wherein the electronic data network is the Internet.